IN THE SPECIFICATION:

Please replace paragraph number **[0001]** with the following rewritten paragraph:

[0001] This application is a continuation of application Serial No. 09/578,255, filed May 24, 2000, ~~pending~~ now U.S. Patent No. 6,592,670, issued July 15, 2003, which is a divisional of application Serial No. 09/170,628, filed October 7, 1998, now U.S. Patent 6,224,936 B1, issued May 1, 2001.

Please replace paragraph number **[0003]** with the following rewritten paragraph:

[0003] State of the Art: The fabrication of integrated circuits on areas of a wafer to ~~form~~ form a discrete semiconductor die thereon is a long and complex process. One of the last steps in the process is that of encapsulating the semiconductor die as a semiconductor device and ~~then~~ attaching the die to a printed circuit board (PCB) or other type die carrier.

Please replace paragraph number **[0008]** with the following rewritten paragraph:

[0008] Materials typically used to encapsulate semiconductor dice mounted on various types of lead frames and to seal metal cans housing semiconductor dice and their carrier, as well as many other components, including potting and molding compounds as well as glob top encapsulants, must provide protection from handling damage for the semiconductor dice and ~~its~~ their carrier in the post processing environment and any subsequent operating environment. Semiconductor ~~die~~ dice are most frequently electrically connected to the lead frame by bonding wires between the bond pads on the semiconductor die and the leads of the lead frame (wire bonding). ~~Flip~~ Flip-chips use small solder balls as interconnects to a substrate and tape automated bonding using thermal compression bonding to form interconnections between the circuits located on the tape and the bond pads of the semiconductor die. Interconnections between substrates and semiconductor dice, as well as other components, are fragile and subject to stress failures. The encapsulant must not generate catastrophic stresses due to the chemical curing process of the encapsulant material or stresses due to differing rates of thermal expansion of the semiconductor die, substrate, and encapsulant during the thermal cycling thereof.

Please replace paragraph number **[0010]** with the following rewritten paragraph:

[0010] Unfortunately, even the best of epoxies still has some level of shrinkage that results in warpage of the underlying substrate, such as a printed circuit board (PCB). The warpage of a printed circuit board can ~~either~~ stress the board enough to either cause it to fail or to cause any of the attached semiconductor devices to fail. Failure of semiconductor devices typically occurs because the solder links between the semiconductor device and the circuits on the printed circuit board failed due to the stress caused by the warpage of the board. Conformal coatings may also incur stress on a surface mounted chip (SMC) during thermal cycling of the chip and printed circuit board causing the solder joints to crack or the components to fracture. Differences between the coefficients of thermal expansion of the encapsulant, the coating, the printed circuit board, and a semiconductor device mounted thereon cause greater stress during thermal cycling. A coating that has a coefficient of thermal expansion (CTE) nearly matching that of the substrate and the semiconductor devices mounted thereon will produce less stress therebetween and attendant cracking when subjected to thermal cycling. Larger ~~surface~~ surface-mounted chips are more vulnerable to damage from stresses during curing of the encapsulant material and thermal cycling of the chip and substrate due to the differences in the coefficient of thermal expansion of the chip and substrate causing stresses therebetween.

Please replace paragraph number **[0011]** with the following rewritten paragraph:

[0011] The thicker the coating or encapsulant thickness of a semiconductor device, the greater the likelihood of stress on the semiconductor device and its connections or interconnects to the substrate from shrinkage of the coating or encapsulant. Some ~~surface~~ surface-mounted chips may not be able to withstand mechanical stresses induced during curing of thick coatings, which may also result in the warpage of the printed circuit board upon which the chip is mounted. If the solder interconnections between a semiconductor device and the circuits of a printed circuit board are closely spaced, conventional coating materials and encapsulant materials may move the semiconductor device, thereby cracking the solder joints as such material cures. In addition, thicker material coatings or thicker encapsulant material may act as barriers to heat transfer from densely packed surface mount chips during the operation thereof.

Please replace paragraph number **[0019]** with the following rewritten paragraph:

[0019] FIG. 6 depicts ~~an SIMM~~ a single-inline-module (SIMM) having a plurality of semiconductor dice; and

Please replace paragraph number **[0023]** with the following rewritten paragraph:

[0023] After sufficient time has elapsed to cure epoxy 20, the clamping elements 16 are then removed by removing the ~~securing~~ retaining elements 18 from clamping elements 16 and support base 12. Once the clamping elements 16 have been removed, the printed circuit board 14 may be removed.

Please replace paragraph number **[0024]** with the following rewritten paragraph:

[0024] Referring to drawing FIG. 2, a second embodiment of the invention is depicted in a perspective exploded view of a clamping fixture assembly apparatus 30 that is used for holding an array, more than one, of printed circuit boards and also serves as an epoxy dam for the application of the epoxy across the surface of the printed circuit boards. Clamping fixture assembly apparatus 30 includes a support base 32 and ~~an overlay bracket,~~ a clamping ~~element,~~ element 34 is secured to support base 32 by retaining elements 42. A plurality of printed circuit boards 36 is placed upon the surface of support base 32 in such a position so as to be exposed by dam apertures 38 that are formed within clamping element 34 when attached to support base 32. A plurality of receiving apertures 40 is located in the outer perimeter corners of support base 32 and is aligned with retaining elements 42 that insert into receiving apertures 40 in support base 32 when the clamping element 34 mates with support base 32. Once clamping element 34 is securely attached to support base 32, the printed circuit boards 36 are retained and exposed through dam apertures 38 in clamping element 34. Next, an epoxy material 44, or any other type of sealant, is applied through ~~the~~ dam apertures 38, the perimeter of which serves as an epoxy dam during the application of the epoxy to the surface of printed circuit boards 36. Next, the clamping fixture assembly apparatus 30 having printed circuit boards contained therein is cured at ambient temperature, or may be cured in an oven to decrease the curing time of the epoxy.

While being retained within a secured clamping fixture assembly apparatus 30, the epoxy 44 on the printed circuit boards 36 cures with minimal warpage of the printed circuit boards 36.

Please replace paragraph number **[0025]** with the following rewritten paragraph:

[0025] Referring to drawing FIGS. 3 and 4, illustrated is a cross-sectional schematic diagram of a printed circuit board 36 having a semiconductor device 46 located thereon. As can be seen in FIG. 4, printed circuit board 36 is substantially planar, having no warpage curvature thereof to cause problems. In contrast, as illustrated in drawing FIG. 3, a printed circuit board 36 having a semiconductor device 46 located thereon exhibits substantial warpage. Returning to drawing FIG. 4, for example, if printed circuit board 36 were a single-inline-memory-module (SIMM), any warpage found in printed circuit board 36 would prevent the printed circuit board 36 from being placed within a single-inline-memory-module (SIMM) by an automated machine for use on a motherboard having a SIMM socket or slot thereon. In other words, the warpage exhibited in printed circuit board 36 would require the manual insertion thereof in a single-inline-memory-module to align within the substantially parallel channels of circuits on a motherboard. Additionally, once printed circuit board 36 is straightened during the insertion process, the flexing of the printed circuit board 36 into a planar configuration would induce stress therein and possibly fracture any electrical or mechanical bonds between semiconductor device 46 mounted on the printed circuit board 36 and the printed circuit board 36. In greatly exaggerated warpage, the likelihood of any fractures of the bonds between the semiconductor device 46 and printed circuit board 36 or stressing of the printed circuit board 36 would be even greater. Other reasons for controlling or reducing warpage in the printed circuit board 36 are to facilitate subsequent process steps involving the printed circuit board 36 by having a greater degree of planarity of the printed circuit board 36 for dicing, marking, labeling, ~~the~~ or the addition of other components to the board, particularly where solder reflow processing is required, etc.

Please replace paragraph number **[0027]** with the following rewritten paragraph:

[0027] In order to determine the advantages of clamping a printed circuit board 14, 36 during encapsulation of semiconductor devices mounted thereon, a series of tests ~~were~~ was performed using various encapsulation materials having various dispensing weights and ~~having~~ various curing temperatures to compare printed circuit boards having no use of a fixture to retain the board and a printed circuit board retained in a clamping fixture assembly apparatus as described herein. A 16 megabyte semiconductor die mounted in a ~~chip on~~ chip-on-board configuration (COB) in a single-inline-memory-module (SIMM) board was utilized as the baseline or standard printed circuit board. An Asymtek 402b gantry glob top system was utilized to dispense a centralized rectangular pattern of Hysol 4451 material in a dam configuration on the single-inline-memory-module (SIMM) board with the dam configuration having a surface dimension of 2.34 inches by 0.60 inches. The dam material was dispensed at a weight of 0.15 grams. The dam was allowed to cure for one hour at 150° C. in an assembly clean room burn-in oven. After the rectangular dam had been created on the single-inline-memory-module (SIMM) board, a glob top film material was dispensed into the dam region under an array of various process conditions as noted.

Please replace paragraph number **[0028]** with the following rewritten paragraph:

[0028] The glob top materials were selected from Hysol 4450, which has a standard coefficient of thermal expansion (CTE) of 19, Hysol CNB558-13, which has ~~a coefficient of thermal expansion (CTE)~~ CTE of 12, and TraBond FS503, which has ~~a coefficient of thermal expansion (CTE)~~ CTE of 35. Each of these glob top materials was applied into the rectangular dam region at various dispense weights ranging from 0.8 grams to 1.6 grams. The thickness of the material was held constant at 0.040 inches. Different cure temperatures and times were also tested. A first cure temperature of 165° C. was used with a time of 45 minutes and a second cure temperature of 120° C. was used for 150 minutes. Both a free state of the single-inline-memory-module (SIMM) board and a restrained state of the single-inline-memory-module (SIMM) board in a clamping fixture assembly apparatus were

observed during the curing of the glob top material at the predetermined curing temperatures and curing times.

Please replace paragraph number **[0029]** with the following rewritten paragraph:

[0029] After the glob top encapsulation had been completed, an optical comparitor was used to measure the deflection of the single-inline-memory-module (SIMM) board to determine the board warpage. A test fixture was made to screw down one end of the single-inline-~~memory-~~ memory-module (SIMM) board to an aluminum block and then the other end of the board was allowed to bow upward freely. The quantitative value of board deflection was then measured from the top of the aluminum block to the bottom of the single-inline-memory-module (SIMM) board.

Please replace paragraph number **[0030]** with the following rewritten paragraph:

[0030] At a dispense weight of 1.4 grams, having a thickness of approximately 0.040 inches, the TraBond FS503 had a free deflection of 140 mils. for the single-inline-~~memory-~~ memory-module (SIMM) board and a restrained deflection for the single-inline-memory-module (SIMM) board of approximately 95 mils. when cured for 45 minutes at 165° C. When cured at 120° C. for 150 minutes, the TraBond FS503 reduced the free deflection for the single-inline-memory-module (SIMM) board of 100 mils. and a restrained deflection for the single-inline-memory-module (SIMM) board of 70 mils. The Hysol 4450 epoxy when cured at 165° C. for 45 minutes resulted in a free deflection for the single-inline-memory-module (SIMM) board of nearly 130 mils. and a restrained deflection for the single-inline-memory-module (SIMM) board of approximately 65 mils. When cured at 120° C. for 150 minutes, the Hysol 4450 epoxy resulted in a free deflection for the single-inline-memory-module (SIMM) board of 95 mils. and a restrained deflection for the single-inline-memory-module (SIMM) board of 48 mils. Further, the Hysol 558-13 epoxy when cured at 165° C. for 45 minutes resulted in a free deflection for the single-inline-memory-module (SIMM) board of approximately 80 mils. and a restrained deflection for the single-inline-memory-module (SIMM) board of 45 mils. The Hysol 558-13 material when cured

at 120° C. for 150 minutes resulted in a free deflection for the single-inline-memory-module (SIMM) board of 25 mils. and a restrained deflection for the single-inline-memory-module (SIMM) board of about 18 mils.

Please replace paragraph number **[0031]** with the following rewritten paragraph:

[0031] All of the variables heretofore noted do contribute in some degree to the warpage of the printed circuit board during curing of an encapsulant material, glob top material, etc. To improve the results and thereby minimize warpage of the printed circuit board during curing of an encapsulant material, glob top material, etc., it is important to match the coefficient of thermal expansion (CTE) of the material to that of the printed circuit board. For example, a glob fill coefficient of thermal expansion (CTE) of 12 obtains better results when used with high temperature FR4 boards having a thickness of 0.50 inches. Additionally, the amount of material dispensed across the surface of the printed circuit board is also directly proportional to the amount of warpage. Further, a lower cure temperature of the material significantly reduces board warpage and restraining the printed circuit board (PCB) during the cure process of the material dramatically reduces the warpage of the board.

Please replace paragraph number **[0032]** with the following rewritten paragraph:

[0032] Referring to drawing FIG. 5, depicted is a cross-sectional schematic diagram of an alternative third embodiment of the clamping fixture assembly apparatus of the present invention used to eliminate or reduce warpage in a printed circuit board (PCB) that has encapsulant material, such as an epoxy, applied to the surface thereof. Clamping fixture assembly apparatus 50 is formed in a u-shaped configuration including rails for restraining the edges of the printed circuit board while curing the encapsulant material located thereon and during any processing of the board. Clamping fixture assembly apparatus 50 includes opening 52, which accommodates a suitable printed circuit board 36 which may be contained therein having retaining shoulders 54 clamping the edges of the printed circuit board 36. Opening 52 has a thickness 56 substantially matching that of the thickness of printed circuit board 36. Again, clamping fixture assembly apparatus 50 may have a slight radius of curvature,

either convex or concave, to induce or counter a curvature in the printed circuit board 36. Once printed circuit board 36 is removed from the clamping fixture assembly apparatus 50, the printed circuit board 36 will flex, bow, or curve in the opposite direction of the induced curvature by the clamping fixture assembly apparatus 50. Thus, the counter bow or curvature of the clamping fixture assembly apparatus 50 tends to offset, counteract, or nullify any warpage caused by the shrinkage during the curing of encapsulation material, such as epoxy, resulting in a substantially flat or planar printed circuit board 36 having no substantial warpage thereof.

Please replace paragraph number **[0033]** with the following rewritten paragraph:

[0033] Referring to drawing FIG. 6, a single-inline-memory-module (SIMM) 60 is illustrated. The ~~module~~ SIMM 60 includes a plurality of semiconductor devices 62 mounted on a substrate ~~14~~, a printed circuit board 14, having apertures 66 therein and having electrical circuits 64 extending along one edge thereof. The semiconductor devices 62 on the ~~substrate~~ printed circuit board 14 may be encapsulated with a suitable material being applied and cured while the ~~substrate~~ printed circuit board 14 is retained in a clamping fixture assembly apparatus such as described herein to help control the warpage of the ~~substrate~~ printed circuit board 14.

Please replace paragraph number **[0034]** with the following rewritten paragraph:

[0034] Referring to drawing FIG. 7, a clamping fixture assembly apparatus 70 is illustrated including a support base 72 and clamping element 74. The support base 72 includes a plurality of apertures 76 therein for receiving portions of clamping element (not shown) therein to retain the clamping element 74 thereon. The clamping element 74 includes a plurality of rectangular dam apertures 80 ~~thereon~~ therein for the application of a suitable encapsulant material therein with the edges of the apertures 80 serving as dams to retain the material therein to cover a semiconductor device located on a ~~substrate,~~ substrate or a printed circuit board (not shown) and a plurality of apertures 78 for receiving portions ~~of~~ of a retaining element therein to retain the clamping element 74 on the support base 72 for the application and curing of an encapsulant to the board for any subsequent processing of the board, such as the dicing thereof.

Please replace paragraph number **[0036]** with the following rewritten paragraph:

[0036] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions, and substitutions are ~~possible,~~ possible without departing from the scope and spirit of the invention as disclosed in the accompanying claims.